IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ***et al.*****,**	)	
	)	
Plaintiffs**,**	)	
	)	
v.	)	**Case No. 4:05-cv-00329-GKF-PJC**
	)	
TYSON FOODS, INC., ***et al.*****,**	)	
	)	
Defendants**.**	)	
	)	

DECLARATION OF DR. FRANK COALE, Ph.D.

1. My name is Frank J. Coale. I am a Professor of Soil Science and Department Chair of the Department of Environmental Science and Technology at the University of Maryland.

2. I have been retained by the Defendants in this matter to assess various issues in this lawsuit relating to agronomics, and also to assess and comment on the testimony of Plaintiffs' expert Dr. Gordon Johnson.

3. I previously authored and submitted to my clients an expert report detailing my work and conclusions in this matter pertaining to agronomics. I also co-authored a report pertaining to damages-related issues along with Dr. John Connolly and Dr. Tim Sullivan. I understand that these reports have been served on Plaintiffs. I incorporate those reports herein by reference.

4. If called to testify at trial, I would testify consistent with the opinions expressed in those reports.

I declare under penalty of perjury that the foregoing is true and correct.

Executed 5 June, 2009.

Frank J Coale

Dr. Frank Coale
University of Maryland

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA

STATE OF OKLAHOMA, ex rel.	**)**
W. A. DREW EDMONDSON, in his capacity as	**)**
ATTORNEY GENERAL OF THE STATE OF	**)**
OKLAHOMA and OKLAHOMA SECRETARY	**)**
OF THE ENVIRONMENT C. MILES TOLBERT,	**)**
in his capacity as the TRUSTEE FOR NATURAL	**)**
RESOURCES FOR THE STATE OF OKLAHOMA,	**)**
	)
Plaintiff,	**)**
	)
vs.	**) 05-CV-0329 GKF-SAJ**
	)
TYSON FOODS, INC., TYSON POULTRY, INC.,	**)**
TYSON CHICKEN, INC., COBB-VANTRESS, INC.,	**)**
AVIAGEN, INC., CAL-MAINE FOODS, INC.,	**)**
CAL-MAINE FARMS, INC., CARGILL, INC.,	**)**
CARGILL TURKEY PRODUCTION, LLC,	**)**
GEORGE'S, INC., GEORGE'S FARMS, INC.,	**)**
PETERSON FARMS, INC., SIMMONS FOODS, INC.,	**)**
and WILLOW BROOK FOODS, INC.,	**)**
	)
Defendants.	**)**

DECLARATION OF FRANK J. COALE, Ph.D.
November 26, 2008

1. Introduction
   a. I, Frank J. Coale, earned a B.S. degree in Agronomy from the University of Maryland in 1981. I then continued on for graduate study at the University of Kentucky where I earned a M.S. degree in Crop Physiology in 1983 and a Ph.D. in Soil Fertility and Plant Nutrition in 1986. I was employed as Assistant Professor of Agronomy at the University of Florida, Everglades Research and Education Center, from 1986 until 1991. In 1991, I was promoted to Associate Professor with tenure at the University of Florida, where I was employed until 1993. At that time, I was hired as Associate Professor of Soil Science, with tenure, at the University of Maryland. In 2002, I was promoted to Professor of Soil Science. In 2005, I became Department Chair for the Department of

Natural Resource Sciences and Landscape Architecture at the University of Maryland. In 2006, I was appointed the inaugural Chair of the University of Maryland's newly formed Department of Environmental Science and Technology. Currently, I am Professor of Soil Science and Department Chair of the Department of Environmental Science and Technology, University of Maryland. Details of my education and employment history are included in the attached curriculum vitae.

b. Over my professional career, I have edited one book, written six book chapters, and published 48 refereed journal publications. I also have written 163 Extension education publications for a variety of audiences. Details of my publication record are included in the attached curriculum vitae.

c. I have delivered 52 invited professional presentations and 80 volunteered presentations at numerous professional society meetings. Additionally, I have given 167 general Extension education talks to a wide variety of lay audiences and 277 professional technical training sessions in the area of soil fertility, nutrient management and plant nutrition. Details of my professional presentations are included in the attached curriculum vitae.

d. I have served as academic advisor to 25 graduate students (15 M.S., 10 Ph.D.) and have supported my research and extension programs with over $11 million in external grant support. Details of my graduate student advising and grants are included in the attached curriculum vitae.

2. Professional Service

a. I have been retained by the defendants in this case to offer professional opinions on a variety of topics within my area of professional expertise. For such services, I require compensation at the rate of $250/hour, plus reimbursement of direct expenses.

3. Poultry litter as a source of plant nutrients

a. For some farming operations, poulty litter is a readily available and relatively inexpensive source of plant nutrients that can be used to satisfy crop nutrient requirements. Poultry litter contains each of the sixteen nutrient elements that are essential for plant growth: carbon (C) , hydrogen (H), oxygen (O), nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), boron (B), manganese (Mn), zinc (Zn), copper (Cu), molybdenum (Mo), chlorine (Cl). Although C, H, and O are sequestered by plants from the atmosphere through photosynthesis, the remaining thirteen essential nutrient elements are acquired from the soil by plant roots. In order for plants to grow efficiently and maximize biomass production, an adequate supply of each of the thirteen soil-derived essential nutrients must be available for plant uptake within the root zone. The thirteen soil nutrient elements are frequently categorized into three groups based on the relative quantity of each nutrient required by the plant:

Macronutrients – N, P, K
Secondary nutrients – Ca, Mg, S
Micronutrients – Fe, B, Mn, Zn, Cu, Mo, Cl.

Contrary to a statement presented in Section 4a of Dr. Gordon Johnson's expert report (Expert Report of Gordon V. Johnson, Ph.D., May 13, 2008), it is incorrect to categorically equate the relative quantity of each essential plant nutrient required by plants and the frequency of deficiency of any specific nutrient in soils. The level of sufficiency or deficiency of any individual plant nutrient in a soil is highly site specific and is dependent on geologic soil parent material, soil organic matter mineralization, and past land management. For example, micronutrients such as B, Mn and Zn are required in relatively small quantities by plants, but while the quantities availabile for plant uptake are sufficient in most soils, they may be critically deficient in other soils. Nutrient availability for plant uptake from soils is highly variable and dependent on specific chemical and physical characteristics of the soil and past site management.

b. Although micronutrients are needed in very small quantities, they are essential, none the less. In most agricultural field production situations, sufficient quantities of micronutrients are available as the result of organic matter decomposition and mineral weathering in the soil. However, micronutrient deficiencies do occur and when they do, they must be corrrected by addition of the deficient micronutrient to the soil or plant foliage in order for the crop to reach full production potential. Production fields that have a history of poultry litter application rarely exhibit micronutrient deficiencies because of the micronutients supplied with litter applications. Poultry litter is an effective source of plant micronutrients.

c. The secondary plant nutrients (Ca, Mg, S) are needed in substantially larger quantities by plants than micronutrients and the availability from the soil resource must be adequate for plants to thrive. Poultry litter application to cropland at normal rates generally supplies adequate Ca, Mg and S to ensure a sufficient supply of these nutrients.

d. Frequently, Ca and Mg nutrition is associated with the practice of liming, or applying soil amendments to neutralize soil acidity. Maintaining soil within a crop-specific optimum pH range is essential for crop production. Liming products are soil amendments that are commonly made of Ca-carbonate or Ca+Mg-carbonate materials. More rarely, Ca-hydroxide or Ca-oxide materials are used. The resulting effect of applying liming materials to acidic soil is displacing soil-adsorbed H-ions (acid) with applied Ca and/or Mg and subsequent neutralization of soil acidity by reaction of the applied carbonate (or hydroxide or oxide) with soil acids. Poultry litter application as a soil amendment to acidic soil typically increases soil pH (decreases acidity) by neutralization of soil acidity by the same mechanism as agricultural limestone amendment applications. Poultry litter is an effective liming material.

e. Plants need macronutrients (N, P, K) in the largest quantity of all soil-derived plant nutrients. Most soil fertility and plant nutrition decisions made by farmers and their nutrient consultants focus on ensuring a sufficient supply of plant-available N, P and K. Soil testing is a widely adopted practice for monitoring the plant availabilty of P and K.

f. In Section 5a and Section 7c of Dr. Gordon Johnson's expert report (Expert Report of Gordon V. Johnson, Ph.D., May 13, 2008), Dr. Johnson refers to nitrogen (N) soil tests and soil testing procedures for determining the amount of nitrogen (N) fertilizers that should be applied to agricultural fields to achieve optimum crop yields. Soil nitrate concentrations are highly transient in agricultural soils and may result from application of any N-containing material to the soil or from natural microbiological mineralization of soil organic matter. Soil testing procedures for predicting seasonal plant-available soil N are not reliable, nor commonly used, for forage crops grown in the temperate, humid portions of the United States, including the Arkansas and Oklahoma portions of the Illinois River Watershed. In this region, the fundamental tenets of soil-test correlation and calibration that have underpinned the development and reliability of soil tests for P have not been established for N soil-testing procedures. The failure of developing a trusted N soil test is not surprising. The very rapid chemical and biological transformations in the forms of N in the soil result in rapid shifts in the relative dominance of different soil N compounds. The natural shifting among N species have thwarted the development of a reliable soil test for N that can be used in the eastern United States, including the IRW. Subsoil nitrate sampling is occasionally recommended as an attempt to quantify subsoil N reserves, but this practice has limited utility and is very infrequently practiced in pasture production systems.

g. Poultry litter can be a valuable source of nutrient N, P and K. Most of the P and K (80-90%) is readily available for crop uptake and utilization after field application. The N in poultry litter exists in both inorganic (ammonium, nitrate) and organic forms. The ammonium and nitrate components of litter N are readily available for crop uptake following application. Generally, the organic N in poultry litter must be mineralized by soil microorganisms to inorganic forms before it is available to the plant. Approximately 50-60% of the organic N in poultry litter is mineralized to inorganic, plant available forms of N during the first year after field application. An additional 15-20% of applied organic N is mineralized in the second year after application.

h. Poultry litter is a heterogeneous mixture of nutrients, organic matter, minerals and water derived from the animals, their excrement, bedding material, animal feed, litter amendments, and dust/soil. When managed at the farm level, poultry litter is a single product. It is not divided into its constituent components which can be managed independently. The woodchips can not be separated from the bird feces. Similarly, the nutrient element constituents of poultry litter are not readily separable. For example, N is not separated from the P and the P is not separated from the K. Farm management decisions regarding utilization of poultry litter nutrients must be based on the most efficient and effective use of the single product: poultry litter. Poultry litter applications to cropland must be managed so that the farmer will experience the maximum cost-effective agronomic benefit from the litter application, maximizing farm sustainability, while minimizing the potential for negative impacts on the surrounding ecosystem.

i. The primary reason farmers apply poultry litter to pastures is as a source of plant-available nitrogen (N). Nitrogen is a macronutrient that is required in relatively large quantities by grass forage plants. For some farmers, poultry litter is a readily available and cost-effective source of nitrogen fertilizer that enhances forage grass production and permits increased capacity to feed and grow pasture-grazed beef cattle. Additionaly, farmers may benefit from the secondary nutrients, micronutrients, organic matter additions, and liming benefits derived from poultry litter applications.

j. Elemental P does not exist as a isolated element in nature. Additionally, unreacted phosphoric acid (H_3PO_4) exists only under laboratory conditions where H^+ is the only cation present. I am in agreement with Dr. Gordon Johnson's summary of the "Behavior of Phosphorus in Soils and the Environment" (Section 3a, Expert Report of Gordon V. Johnson, Ph.D., May 13, 2008) that stated that elemental P does not exist in nature and the unreacted phosphoric acid does not exist in the natural soil environment.

k. Accordingly, neither elemental P nor phosphoric acid are constituents of poultry litter. Neither elemental P nor phosphoric acid are products of poultry litter decomposition and mineralization following land application to agricultural production fields.

l. I have conducted research utilizing poultry litter and studied the academic literature on poultry litter for over 15 years. I reviewed the list of elements, chemicals and compounds claimed to be components of poultry litter that was presented in the Expert Report of Roger Olsen (Section 6.4.3.5 "Hazardous Substances in Poultry Waste"). Based on my experience and knowledge of the pertinent literature, the following are entries listed in the Expert Report of Roger Olsen, Section 6.4.3.5, that are not typically found in routine analysis of poultry litter from commercial poultry production facilitites. My opinion is based on my personal knowledge, professional expectations, and recollection of the literature pertaining to typical commercial poultry litter.

Cadmium and compounds
Nitric acid
Nitrosamines
Phosphoric acid
Polynuclear aromatic hydrocarbons
Radionuclides
Sulfuric acid
Thiourea
Unlisted hazardous waste with characteristics of reactivity

4. Poultry litter use in a pasture-based beef cattle production system

a. Nitrogen is typically the largest input nutrient required for management of pasture grasses used in a pasture-grazed beef cattle production system. Nitrogen fertilizer application rates are based on forage production potential or pasture yield goal. Realistic forage crop yield goals are determined by forage species grown, pasture density, soil type, climate, and management expertise. Historical production records are usually used to determine future yield goals. Recommended application rates for other crop nutrients and soil amendments (P, K, lime, etc.) are based on established soil testing procedures.

b. Poultry litter from the cleanout of poultry houses may be an economical source of fertilizer nutrients to support the pasture grasses for beef cattle production . Historically, litter applications to grass pastures usually have been based on the N fertilization rate needed to achieve a forage production goal. Even if soil-test P levels are adequate, N must be applied to maintain pasture productivity. Poultry litter may be the most economical source of N available to the farmer to fertilize grass pastures and, on the farm, the N in poultry litter can not be managed separately from the P content of the poultry litter. Recently enacted regulations that limit poultry litter application to P-based rates can create scenarios in which farmers and ranchers may no longer be able to meet the total N need for the forage crop from poultry litter applications. In such cases, commercial fertilizer N must be applied to reach forage production goals.

c. For grass pasture-based beef cattle grazing systems in which poultry litter or other fertilizers are utilized as a fertilizer source, the impact of grazing cattle is important when evaluating soil P dynamics. The root systems of forage grasses accumulate inorganic soluble soil P from deep below the soil surface and convert it to organic P in the above ground tissues of the forage grass. Grazing cattle ingest the grass tissue, retain some of the ingested P to satisfy their growth and metabolic needs and deposit manure onto the soil surface that contains a combination of organic and inorganic P. The manure P that is deposited onto the soil surface by grazing cattle is subject to a variety of fates including recycled uptake by pasture plants and transportation with surface runoff and leaching waters.

5. Concern about "high P" soils

a. In many states, regulations have been enacted in response to concerns about "high P" soils. Oklahoma regulations are in the form of the NRCS Code 590 Standard and Arkansas has enacted rules that utilize a Phosphorus Index approach to regulate the potential for agricultural P pollution. Various definitions have been used, worldwide, to define "high P" soils from an environmental protection perspective. Typically, "high P" soils are defined to be somewhere beween three and five times the agronomic optimum soil-test P level. "High P" soils are not classified as such because they are detrimental to plant growth or hazardous to animal life. As a rule, direct P toxicity in agronomic crop prodution systems is unheard of.

b. Additionally, it is important to remember that there is always some potential background level of P that may be transported off-field with field drainage water. This is true even from low soil-test P fields. Any drainage water that flows over or though a soil will contain a certain background load of P. In any ecosystem that includes soil, there is no such thing as zero P discharge.

c. Soil-test P buildup and decline is not elastic. Numerous historic soil-test calibration studies have determined the quantity of added fertilizer P that is necessary to increase the STP by a single pound per acre. Development of this calibration ratio is regionally and soil-type specific and requires many years of on-farm field trials conducted at multiple locations. Dr. Gordon Johnson stated that historic calibration studies determined that applied P that is in excess of crop uptake will accumulate in the soil and raise the STP about 1 pound STP per acre for every 10 to 15 pounds of excess P_2O_5 per acre (Section 6c, Expert Report of Gordon V. Johnson, Ph.D., May 13, 2008). Dr. Johnson further states that, "Similarly, when no P is added the STP will decrease by about the same factor" (Section 6c, Expert Report of Gordon V. Johnson, Ph.D., May 13, 2008). Research has repeatedly demonstrated that when soil P levels have been substantially elevated by multiple years of manure and/or fertilizer P applications and these soils are continuously cropped without application of additional fertilizer or manure P, soil P concentrations do not uniformly decline following a simplistic elastic pattern that mimics the opposite of STP increase when fertilizer P is added (Kratochvil et al., 2006, International Journal of Phytoremediation, 8:117-130; McCollum, 1991, Agronomy Journal, 83:77-85; Read et al., 2007, Agronomy Journal 99:1492-1501). The kinetics of soil P mineralization and dissolution, combined with the rate of P removal by crop harvest, will control the rate of STP decline over time. Thus, since the rate of STP decline when no additional P is added to the soil while crop harvest continues is unknown, the hypothetical model of STP decline over time that was developed by Dr. Johnson (Section 6c, Expert Report of Gordon V. Johnson, Ph.D., May 13, 2008) is not quantitatively defensible and has no apparent application.

From my evaluation, the hypothetical model derived by Dr. Johnson to describe STP decline over time (Section 6c, Expert Report of Gordon V. Johnson, Ph.D., May 13, 2008) appears to be a pure academic exercise that was neither developed from physical data nor validated by independent datasets and, thus, has no predictive capacity.

d. Various states and watershed regions have adopted nutrient management regulations that include restrictions on land application of animal manures and commercial fertilizers. To the best of my knowledge, all current regulations are based on the potential for nutrients, usually N and P, loading to surface water.

e. Elevated soil-test P level does not necessarily translate to elevated P delivery to water bodies. In order for P losses from an agricultural field to be of heightened ecological concern, the site must contain both a substantial source of P and active pathways through which the P may be transported to an adjacent body of water. It is necessary for a specific site to possess both a large quantity of potentially transportable P (P source) and an effective pathway for transporting P off of the field and into surface water. Major sources of P include commercial fertilizers, animal manures, municipal biosolids, and background or soil-derived native P.

f. Every site contains a specific set of characteristics that control the potential for P loss in drainage water. Some sites contain a substantial source of P but do not exhibit realistic transport pathways for movement of the P source to the water body. Other sites may have a much smaller source of P, but the potential for transport of that P source to a water body is very high. The site-specific nature of P transport from production pastures in the Illinois River Watershed (IRW) was exemplified by the edge-of-field runoff water sample collection challenges described in Dr. Roger Olsen’s expert report (Section 2.3.7, Expert Report of Dr. Roger Olsen, 2008). Dr. Olsen reported that edge-of-field runoff water “sample capture tubes” were buried at pre-determined locations where surface runoff was expected to occur at the edge of the pasture. Over time, Olsen concluded that this procedure was not effective for capturing runoff water samples “because it proved difficult to reliably identify locations where sufficient runoff volume could be collected.”

g. In both the Expert Report of Dr. Berton Fisher (Opinion #19, page 44-46) and the Expert Report of Dr. Roger Olsen (Section 6.3), the authors discuss the mantled karst geology of the IRW and the fractures, faults and sinkholes in the underlying limestone that are characteristic to this type of terrain. The soil surface slope, soil textural composition (% sand, % silt, % clay), depth, bulk density and porosity of the soil that overlies the fractured limestone bedrock will determine the runoff, infiltration and percolation potential of rainfall that falls on a particular site. In the IRW that is dominated by karst geologic features and a mixture of relatively flat landscapes and differentially eroded hillslopes, surface runoff and infiltration will be highly spatially variable. Evaluation of runoff potential must be conducted on the single field or sub-field scale. Dr. Fisher and Dr. Olsen both recognized the extreme spatial variability in surface water hydrology and the variability in the occurance of potential pathways for phosphorus transport.

h. Any assessment of potential P losses must be site specific and must encompass multiple characteristics of both the physical site and the characteristics of the P source. In summary, the site assessment must be able to identify "critical source areas" for P loss, as conceptualized in Figure 1.

When considering potential transport pathways, it is critical to understand that surface runoff is not generated from every pasture field. Surface runoff is a combination of overland water flow and shallow, lateral interlayer flow that eventually emerges to the surface. As discussed above in Section 5g, the site-specific physical characteristics of a particular field will determime the potential for surface runoff following a rainfall event. If the soil's water infiltration rate and percolation rate are greater than the rate of rainfall, then no runoff will be generated. Additionally, if surface runoff is generated following a rainfall event, the surface runoff may or may not reach a stream, lake or other water body. Surface runoff generated in a particular pasture field may drain into an adjacent pasture, an adjacent woodland, a riparian stream buffer, a grassed roadside swale, or any number of other physical settings that may not provide direct conveyance to surface water. The degree of connectivity of the runoff-producing pasture field to the nearest stream must be evaluated on a site-specific, field by field basis. The concept of variable source areas for generation of surface runoff has been well established over the past decade. Variable source area hydrology refers to situations where a small portion of the land area in a given subwatershed generates most of the surface runoff. In summarizing a series of studies in highly instrumented watersheds in the ridge and valley region of central Pennsylvania conducted by USDA-ARS researchers, approximately 80% of the surface runoff water volume was generated from 20% of the land surface area (Pionke et al., 2000, Ecological Engineering 14:325-335; Gburek and Sharpley, 1998, J. Environ. Qual. 27:267-277; Gburek et al., 2000. J. Environ. Qual. 29:130-144.). The terrain of the IRW would be expected to provide a similar demonstration of this variable source area hydrology.

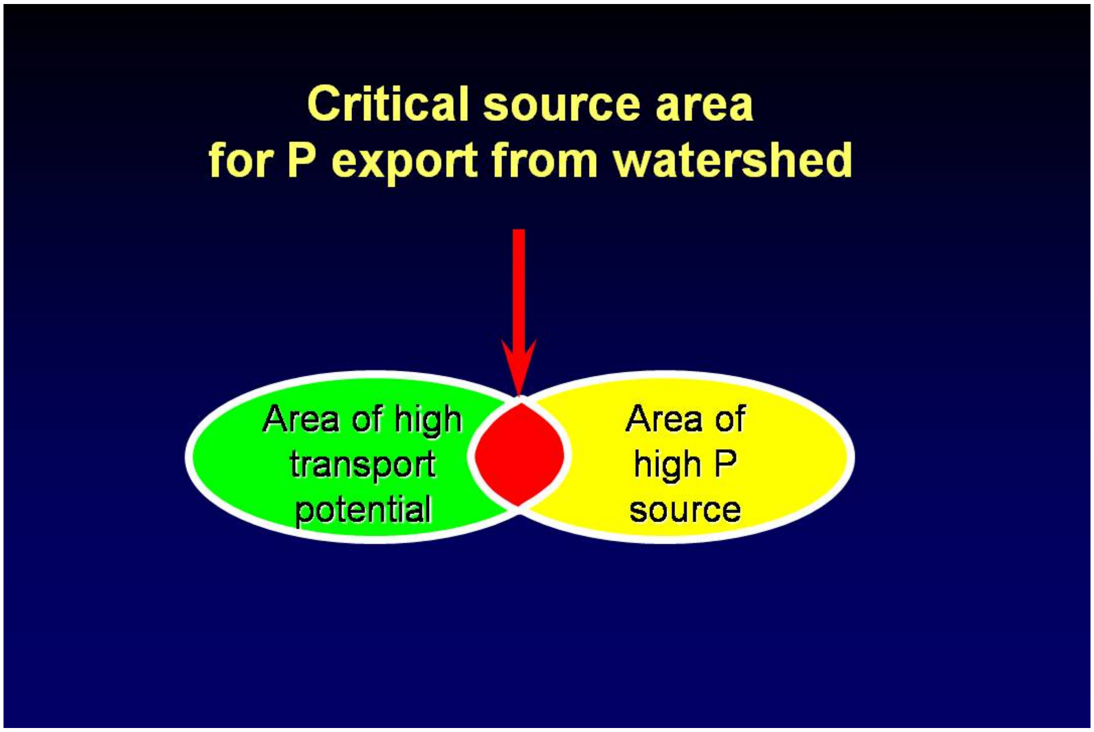

Figure 1. Concept of a critical source area for P export from an agricultural watershed.

6. In Section 8.1, Expert Report of Dr. Bernard Engel (May 22, 2008), Dr. Engel indicates that "5% of poultry waste applied to land is lost in surface runoff," and cites published research (Sharpley, et al., 2007. Journal of Soil and Water Conservation, 62:375-389) to justify this claim. It is my opinion that the generic estimate that 5% of poultry litter P applied to pastures is transported to natural surface waters via surface runoff pathways is not realistic. Estimates of P transport from site of poultry litter land application to a potential receiving water must be evaluated on a case-by-case, site-specific basis. For specifc locations, the actual percentage of pasture-applied poultry litter P that is transported to streams in the IRW may be substantially less than 5% because:

    a. The 5% runoff estimate assumes that all runoff from all pasture fields will enter a stream. As outlined above in Section 5j, this definitely is not the case in the IRW.

    b. From a personal conversation with Dr. Sharpley, I learned that the 5% estimate reported by Sharpley et al. (2007) was based on numerous natural and simulated rainfall studies conducted over many years and locations. For most of the studies evaluated to derive the 5% runoff estimate, the poultry litter application rates were higher (approx. 5 tons/acre) than current normal practice in the IRW. Also, simulated rainfall studies were designed to create a "worst case scenario" in which relatively high rates of poultry litter were subjected to extremely intense simulated rainfall (approx. 3 inches per hour) immediately (approx. 1 to 2 days) after surface application. These experimental conditions maximize P loss in surface runoff. Real-world P runoff losses would be expected to be less and would be dependent on site-specific field characteristics.

c. Edge-of-field P losses in surface runoff determined from small runoff plot experiments utilizing rainfall simulators are typically overestimates of real-world conditions. Standardized small plot rainfall simulation protocols aim to approximate a very intense one-in-ten-year rain storm event (http://www.sera17.ext.vt.edu/Documents/National_P_protocol.pdf). In these controlled studies, surface runoff water samples are collected immediately adjacent to the rainfall simulator which precludes any P attenuation along the runoff flow path, as would be realized in a natural setting.

7. Soil-test P and soluble P in field runoff

a. Soil soluble P may be transported with surface runoff water only if a runoff event occurs. Measurement of soil soluble P should not be considered synonymous with runoff of soluble P. A soil can have elevated quantities of soil soluble P, but if runoff water does not transport the soil soluble P from the site of origination, then soluble P runoff cannot occur. Soil soluble P must be physically transported from the site of origin to a water body in order to have any potential ecological impact.

b. Dr. Gordon Johnson discussed a study by Vadas et al., (2005) who proposed that, for water quality modeling applications, a single extraction coefficient could be used to approximate dissolved P release from soil to runoff based on Mehlich-3 soil-test P measurements (Section 10c, Expert Report of Gordon V. Johnson, Ph.D., May 13, 2008). In modeling applications such as those studied by Vadas et al., (2005), each component of the hydrologic flow path and all factors that control P desorption dynamics must be estimated or approximated in order for the model to predict P movement across a landscape. The linear approximation of dissolved P release used by Vadas et al., (2005) cannot be accurately applied in isolation to approximate soluble P runoff. Soluble P runoff is dependent on runoff water volume. Variable source area hydrology dictates that, in the field, not every parcel of soil will generate runoff water following a rainfall event. Additionally, not all of the runoff that is generated on particular soils will be hydrologically connected with a body of water. Simply because a relationship between soil soluble P and soil-test P has been proposed, it should not be extended to imply that the predicted quantity of soil soluble P is transported from the site of origination with water flow. It is simply an approximation of potential release of soluble P to runoff water if runoff water is generated from that site.

c. In Section 10c of the Expert Report of Gordon V. Johnson (May 13, 2008), Dr. Johnson states that, "Using the prediction equation from this publication (2 times ppm STP = ppb runoff P), the calculated concentrations of runoff P would be 0.038 ppm for the average STP values of counties with < 1,000 tons litter production per year." In order for the preceding statement to be true according to the regression equation presented by Vadas et al., (2005), the mean STP of counties with < 1,000 tons litter would need to be -3 ppm (i.e. negative three ppm or negative 6 lbs/acre STP). This is not possible.

d. In Section 10e of the Expert Report of Gordon Johnson (May 2008), Dr. Johnson further discusses the application of the regression equation presented by Vadas et al. (2005) and states that, "In contrast, when litter application is governed by agronomic benefit from P the concentration would be only 38 ppb even if all the pastureland soils tested 65 lb P/acre." If one applies the regression equation of Vadas et al. (2005) correctly, if all pastureland soils in the entire IRW had STP equal to 65 lb/acre, the predicted soil soluble P level of these soils would be 109 ppb, not the 38 ppb concentration stated by Dr. Johnson. It is not obvious how Dr. Johnson's estimate of 38 ppb was calculated.

e. I had a personal conversation with Dr. Peter Vadas regarding Dr. Johnson's application of Dr. Vadas' published research results. After review of Sections 10c, 10d and 10e of the Dr. Johnson's Expert Report (May 2008), Dr. Vadas concluded that the results from his publication were being correctly quoted by Dr. Johnson, but the application and extension of Dr. Vadas' work may not be correct and, quoting Dr. Vadas, "I'm sure it does not represent reality very well at all." Dr. Vadas continued his evaluation of the application of his research work by Dr. Johnson and summarized that Dr. Johnson's arguments as representations of a scenario in which the agricultural soils in the IRW were fairly uniform. Dr. Vadas correctly asserted that it is more likely that the IRW landscape is a tapestry of STP values ranging from low to very high according to initial background fertility levels and how fertilizers and manures have been applied over the years. Dr. Vadas commented that, the scenario presented by Dr. Johnson, "seems to be a pretty elementary one that does not represent reality and is thus fairly useless." Dr. Vadas concluded that Dr. Johnson utilized Dr. Vadas' published research in an attempt to demonstrate that if one applied P to a soil, STP level will increase and predicted soil soluble P concentrations would also increase. Speaking on behalf of the scientific consensus, Dr. Vadas stated, "We all know that." Dr. Vadas' response demonstrated the need to evaluate phosphorus transport potential on a site-specific, field-by-field basis.

7. Site-specific determination of risk of P loss

a. In order to identify critical source areas for P losses in an agricultural watershed, many site-specific characteristics must be evaluated. Any particular characteristic may bear more or less impact on the overall potential for P loss to surface water at any particular site. The need to effectively evaluate the P loss potential from a specific watershed, sub-watershed, farm, field, or sub-field may necessitate site-specific evaluation at different scales. Typically, accurate assessments are derived from evaluation at the single field or sub-field scale.

b. The established standard for site-specific evaluation of P loss potential is the "Phosphorus Index" (P Index), or similar site-specific evaluation tools known by various names in different jurisdictions. Nationwide, at least 47 states have developed P Indices by modifying a common structure of basic components to make it suitable for local conditions. Such widespread adoption of this indexing concept demonstrates the consensus among scientists, industry and policy makers with regards to the validity of the P Index approach (Maguire et al., www.sera17.ext.vt.edu). Both Oklahoma and Arkansas have adopted P Index

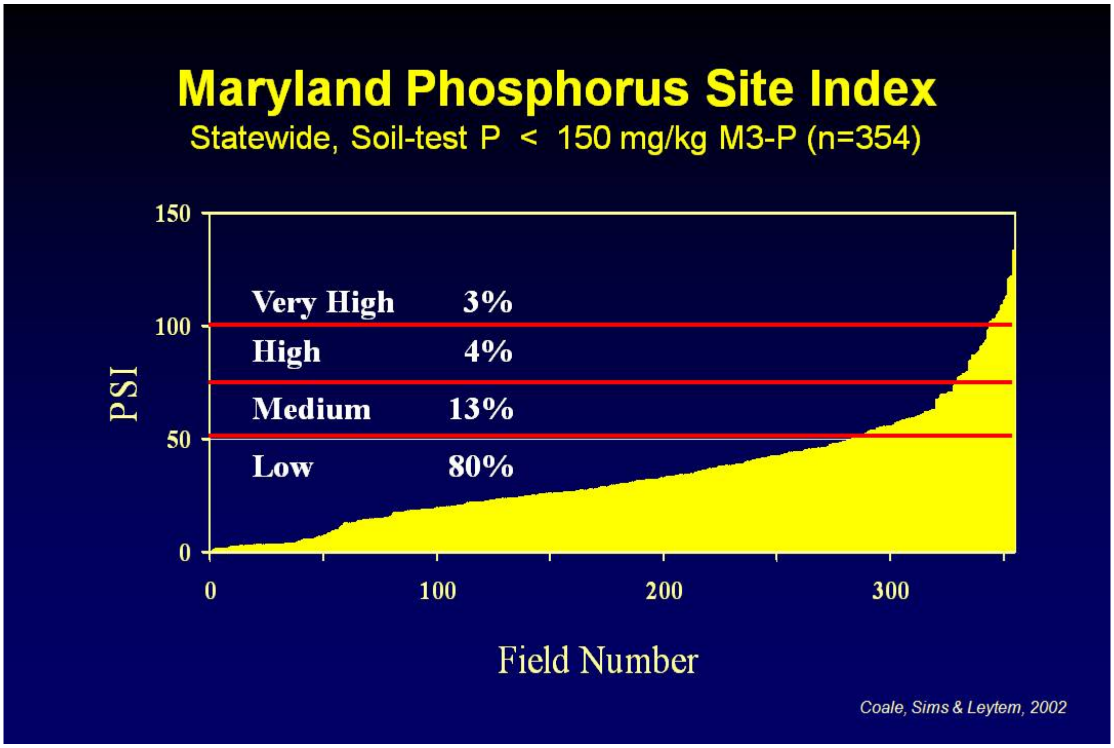

Figure 4. P Index evaluation of relative potential for P loss from 354 farm fields in Maryland that had relatively low P soil, defined by soil-test P level less than 150 mg/kg M3P.

9. Site-specific evaluation of the risk for P losses from agricultural fields is essential in order to accurately assess risk over any given watershed. The site-specific evaluation must include assessment of multiple factors that control the quantity of potentially transportable P that is present in the agro-ecosystem (P source factors) and assessment of multiple factors that control the potential for transport of P from the field (P transport factors) to surface water bodies. We must focus our conservation efforts on the critical source areas where there is evidence of both elevated P source quantities and elevated P transport potential. The scientific community has reached consensus that to blindly ignore either the source or the transport components used to identify the critical source areas for P losses would be negligent (Maguire et al., www.sera17.ext.vt.edu).

10. <u>Summary</u>
    a. The data and analyses presented in the Expert Report of Gordon V. Johnson, Ph.D. (May 13, 2008), do not support the conclusion that application of poultry litter to grass pastures in the Illinois River Watershed constitutes poor agronomic practice, “for all but a few cases”. The chemical, physical and hydrologic properties of soils are highly variable. The physical landscape of the IRW is highly variable. Past land management has undoubtedly been highly variable across the IRW. The combination of these inherently variable factors creates a highly variable and site-specific collection of risk factors that control the potential for P transport from poultry litter application sites to neighboring bodies of water. The degree of risk